INCIDENCE AND MAIN DETERMINANTS OF CONTRAST-INDUCED NEPHROPATHY FOLLOWING CORONARY ANGIOGRAPHY OR SUBSEQUENT BALLOON ANGIOPLASTY

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ABSTRACT

BACKGROUND

Contrast-induced nephropathy is evincing lot of interest as the number of diagnostic and interventional radiologic imaging procedures is on rise.

The aim of this study was to assess the incidence of contrast nephropathy after coronary angiography and to identify the key risk factors of contrast nephropathy after coronary angiography.

MATERIALS AND METHODS

This study was conducted among 51 patients who underwent coronary angiography at cardiac catheterisation lab in Department of Cardiology in Government Rajaji Hospital, Madurai, between October 2014 to March 2015. Contrast-induced nephropathy was defined by an increase in creatinine of >0.5 mg/dL or 25% of the initial value.[1] A careful history and examination was done to assess comorbid conditions such as diabetes mellitus and hypertension, previous exposure to contrast media and drugs and hydration status. Procedural variables including the type of procedure (Diagnostic, interventional), contrast dye load and contrast agent was recorded. Student's 't' test was used to test the significance of association between quantitative variables and Yate's and Fisher's chi-square tests for qualitative variables. A 'p' value less than 0.05 was taken to denote significant relationship.

RESULTS

The incidence of contrast nephropathy was 11.8% among the population studied. The relationship between age and CIN was not statistically significant (p=0.8141). The relationship between diabetes mellitus and CIN was not statistically significant (p=0.2344). The relationship between ejection fraction and CIN was not statistically significant (p=0.5523). The baseline eGFR was not significantly associated with CIN (p=0.5974). The relationship between contrast volume and CIN was not statistically significant (p=0.337). None of the risk factors assessed was significantly associated with CIN.

CONCLUSIONS

The incidence of contrast nephropathy was 11.8% among the population studied. The relationship between age and CIN was not statistically significant (p=0.8141). The relationship between diabetes mellitus and CIN was not statistically significant (p=0.2344). The relationship between ejection fraction and CIN was not statistically significant (p=0.5523). The baseline eGFR was not significantly associated with CIN (p=0.5974). The relationship between contrast volume and CIN was not statistically significant (p=0.337). None of the risk factors assessed was significantly associated with CIN.

KEYWORDS

GFR - Glomerular Filtrate Rate, CIN – Contrast-Induced Nephropathy, Coronary Angiography, Diabetes.

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BACKGROUND

Contrast-induced nephropathy is evincing lot of interest as the number of diagnostic and interventional radiologic imaging procedures is on rise. It is the 3rd common cause of inpatient acute kidney injury (12%) after diminished renal blood supply (42%) and postoperative acute kidney injury (18%).[2]

Intervention have risk factors associated with the development of contrast-induced nephropathy like diabetes mellitus, congestive cardiac failure and pre-existing renal impairment. Contrast load is often high in patients undergoing PCI above the usual safety limit of 100 mL. Contrast-induced nephropathy is a key cause of disability and death in patients undergoing cardiac catheterisation. After percutaneous coronary stenting or angioplasty, published incidence of CIN is between 0 to 24% depending on the prevalence of risk factors and used definition.[3] In our country, studies measuring the incidence of CIN following coronary angiography or angioplasty are sparse. Also, studies in different populations are necessary to identify

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ethnicity, specific risk factors for contrast-induced nephropathy. As, no therapy selectively targets CIN after it occurs, the key goal for physicians rests on prevention. A simple risk score calculated using easily available variables will help in identifying patients at high risk of developing CIN.

Once patients are stratified based on risk, appropriate preventive measures can be instituted.

MATERIALS AND METHODS

This study was conducted in 51 patients who underwent coronary angiography or percutaneous coronary intervention in our Government Rajaji Hospital, Madurai. Institutional ethical clearance was obtained. An individual written and informed consent was obtained from each patient. Detailed history and meticulous clinical examination was done. The drugs given to the patients were also noted. IV saline was given to all patients except those with congestive cardiac failure. The hydration protocol was 1 mL/kg of saline per hour given 12 hours before contrast injection and continued 12 hours after injection. Serum creatinine was measured on the day and 48 hours after contrast agent administration. The baseline eGFR was calculated by MDRD equation as follows:

(186.3 × Serum Creatinine 1.154) × (Age-0.203) × (0.742 if female). ECHO was used to measure left ventricular ejection fraction. The type, amount of the contrast medium and timing of administration was recorded. CIN was diagnosed by either a rise in creatinine of >0.5 mg/dL or 25% of the baseline.

STATISTICAL ANALYSIS

Data analysis was done with the help of Epidemiological Information Package (EPI 2010) developed by Centre for Disease Control, Atlanta. Using this software, range, frequencies, percentages, means, standard deviations, 't' value and 'p' values were calculated. Student's 't' test was used to test the significance of association between quantitative variables and Yate's and Fisher's chi-square tests for qualitative variables. A 'p' value less than 0.05 will denote significant relationship.

RESULTS

The mean age of the study population was 49.9 years. Most of the individuals fell within the 40-60 yrs. age bracket. About 9.8% of individuals were above 60 years of age (Table 1). Among the study population, men comprised 68.6% and women comprised 31.4% (Table 2). Among the study population, 29.4% were diabetics.

About 17.6% of patients had hypertension. Previous history of coronary artery disease was found in 17.6% of patients (Table 3). None of the patients had a history of stroke or chronic kidney disease. ACEI was used in 62.7% of the study population. Metformin was used in 9.8% of study population. The mean haemoglobin was 12.6 g%. The mean random blood sugar was 145.1 mg%. The mean ejection fraction was 46.1%. Among the study population, 41.2% were diagnosed with IWMI. About 43.1% were diagnosed with AWMI (Table 4). Around 9.8% and 5.9% of individuals were diagnosed with CSA and UA, respectively. Among the study population, only 31.4% were thrombolysed, rest were not. In the study population, 68.5% had SVD, 25.5% had DVD. Patients with TVD and SVD (Recanalised LCX), LMCA and TVD were 2% each. In the study population, 94.1% underwent diagnostic coronary angiography, only 5.9% of study group underwent PCI. The mean volume of contrast used was 31.9 mL (Table 5). The mean creatinine concentration was 0.96 mg%. The mean eGFR was 87.9 mL/mins. (Table 6). Among the study population, 11.8% of persons developed contrast-induced nephropathy. None of the risk factors assessed was significantly associated with CIN.

Contrast-Induced Nephropathy	Age (Yrs.)	
	Mean	S.D.
Yes	49.0	10.8
No	50.0	9.6
'p'	0.8141 Not significant	

Table 1: Age and Contrast-Induced Nephropathy

Sex	Contrast-Induced Nephropathy			
	Yes		No	
	No.	%	No.	%
Male (35)	5	14.3	30	85.7
Female (16)	1	6.3	15	93.8
'p'	0.3785 Not Significant			

Table 2: Sex and Contrast-Induced Nephropathy

Co-Morbidity	Contrast-Induced Nephropathy				'p'
	Yes		No		
	No.	%	No.	%	
Diabetes					
Yes (15)	3	20.0	12	80.0	0.2344
No (36)	3	8.3	33	91.7	Not Significant
Hypertension					
Yes (9)	1	11.1	8	88.9	0.7164
No (42)	5	11.9	37	88.1	Not Significant
Peripheral Vascular Disease					
Yes (1)	-	-	1	100.0	0.8824
No (50)	6	12.0	44	88.0	Not Significant
Stroke					
Yes (0)	-	-	-	-	-
No (51)	6	11.8	45	80.2	

Chronic Kidney Disease					
Yes (0)	-	-	-	-	-
No (51)	6	11.8	45	88.2	
Coronary Artery Disease					
Yes (9)	1	11.1	8	88.9	0.7164
No (42)	5	11.9	37	88.1	Not Significant

Table 3: Comorbidity and Contrast-Induced Nephropathy

Diagnosis	**Contrast-Induced Nephropathy**			
	Yes		**No**	
	No.	**%**	**No.**	**%**
AWMI (22)	2	9.1	20	90.9
IWMI (21)	2	9.5	19	90.5
CSA (5)	1	20.0	4	80.0
UA (3)	1	33.3	2	66.7

Table 4: Diagnosis and Contrast-Induced Nephropathy

Contrast-Induced Nephropathy	**Volume of Contrast Used**	
	Mean	**S.D.**
Yes	30.83	2.04
No	32.04	2.95
'p'	0.337 Not significant	

Table 5: Volume of Contrast Used and Contrast-Induced Nephropathy

Contrast-Induced Nephropathy	**Glomerular Filtrations Rate**	
	Mean	**S.D.**
Yes	92.67	32.74
No	87.27	22.06
'p'	0.5974 Not significant	

Table 6: Glomerular Filtration Rate and Contrast-Induced Nephropathy

DISCUSSION

Contrast-induced nephropathy after coronary angiography occurs in a unique population with risk factors that are common to both coronary artery disease and contrast-induced nephropathy. The major risk factors for CIN are pre-existing renal disease and diabetes mellitus. Minor risk factors include Age, Sex, Reduced ejection fraction and hypertension. Procedure-related risk factors include osmolality, amount of contrast agent used and further administration of contrast agents.[4] Large studies studying the incidence and risk factors for CIN in our population are sparse. Acute kidney injury following coronary angiography significantly increases short- and long-term morbidity and mortality. There are some proven measures that can prevent contrast-induced nephropathy. It is necessary to identify the risk factors for CIN to effectively control them. This study was done in 51 patients undergoing cardiac catheterisation in our hospital. The incidence of CIN in our study population was 11.8%. This is comparable to other international studies. But, it must be tempered with the fact that various studies used different diagnostic criteria for CIN. Older age is a non-modifiable risk factor for CIN. The percentage of patients older than 60 years was only over 9% in our study and the relationship between age and CIN was not statistically significant. There was also no relationship between sex and contrast-induced nephropathy. As pre-existing renal disease was an exclusion criteria, this risk factor could not be analysed in our study. Diabetes mellitus has been shown to have strong association with CIN in various studies.

But, our study did not find a significant association. The assessment of microalbuminuria in the diabetic patients could have shed more light, but it was not done in our study.[5] There was no relationship between blood pressure and CIN.

Most of our patients presented in Killip stage 1 and hence a meaningful analysis could not be carried out. There was no correlation between the ejection fraction and CIN. The type of myocardial infarction also did not influence the risk of CIN. This result is similar observations made in other studies.[6]

The volume of contrast used was around 30 mL in most of the patients, hence its effect on CIN could not be assessed. But, it was shown to be a significant risk factor in other studies.[7] The same type of contrast medium was used in all our patients. There was a time interval of more than 72 hours between diagnostic coronary angiography and percutaneous coronary intervention. Hence, the question of repeated exposure could not be assessed. In our study, none of the usual risk factors were significantly associated with CIN. This could be because of the small sample of the population studied. Hence, a larger study might show statistically significant risk factors for CIN in our population.

CONCLUSIONS

The incidence of contrast nephropathy was 11.8% among the population studied. The relationship between age and CIN was not statistically significant (p=0.8141). The relationship between diabetes mellitus and CIN was not statistically significant (p=0.2344). The relationship between ejection fraction and CIN was not statistically significant (p=0.5523). The baseline eGFR was not significantly associated with CIN (p=0.5974). The relationship between contrast volume and CIN was not statistically significant (p=0.337). None of the risk factors assessed was significantly associated with CIN.

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